

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-279689

(43)Date of publication of application : 04.10.1994

(51)Int.Cl.

C08L101/00

C08K 3/00

C08K 3/34

C08K 7/08

C08L 77/00

F16C 33/20

(21)Application number : 05-173964

(71)Applicant : NTN CORP

(22)Date of filing : 14.07.1993

(72)Inventor : KUBOTA KAZUNORI

(30)Priority

Priority number : 05 13527 Priority date : 29.01.1993 Priority country : JP

(54) SLIDING MEMBER COMPOSITION

(57)Abstract:

PURPOSE: To provide the subject composition low in tendency to damage the material of partner in its sliding, having stable sliding performance with a low friction coefficient, and being highly excellent in wear resistance.

CONSTITUTION: The objective sliding member composition can be obtained by incorporating (A) as the major component, a synthetic resin such as polyphenylene sulfide with (B) 1-30vol.% of at least one kind of whisker selected from calcium sulfate whisker, aluminum borate whisker, magnesium sulfate whisker, short fiber-like synthetic calcium silicate hydrate and barium titanate whisker and (C) 3-30vol.% of a solid lubricant such as tetrafluoroethylene resin.

## LEGAL STATUS

[Date of request for examination] 25.05.2000

[Date of sending the examiner's decision of rejection] 22.06.2004

[Kind of final disposal of application other than the examiner's decision of rejection or

\* NOTICES \*

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

CLAIMS

---

[Claim(s)]

[Claim 1] The slide member constituent which comes to add the whisker 1 more than a kind chosen from the group which consists of a calcium-sulfate whisker, a boric-acid aluminum whisker, a magnesium sulfate whisker, a staple fiber-like composition calcium silicate hydrate, and a barium titanate whisker by using synthetic resin as a principal component - 30 capacity %, aromatic polyamide fiber 1 - 30 capacity %, and a solid lubricant 3 - 30 capacity %.

---

[Translation done.]

\* NOTICES \*

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

## DETAILED DESCRIPTION

---

### [Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention relates to the slide member constituent excellent in abrasion resistance about the constituent of slide members, such as plain bearing and a gearing.

[0002]

[Description of the Prior Art] Although attaining lightweight-ization of a member is performed using synthetic resin for bearing and a slide member like a gearing, and securing necessary sliding performance generally, heat-resistant polyphenylene sulfide besides being a polyamide etc. as synthetic resin used as a matrix in that case, polyacetal, etc. are used. And as fibrous reinforcing materials added by such principal component, there are a carbon fiber, aromatic polyamide fiber, and a potassium titanate whisker, and tetrafluoroethylene resin, a graphite, etc. are known as a solid lubricant.

[0003] A wear-resistant high property is also required on the assumption that such a slide member constituent does not damage partner material not to mention being low coefficient of friction to the metal used as sliding partner material, or other synthetic-resin material.

[0004] However, among the above mentioned fibrous reinforcing materials, since a carbon fiber is hard, it is easy to damage sliding partner material, and although the damage degree of partner material is low, a wear-resistant improvement effect is enough [ neither aromatic polyamide fiber nor a potassium titanate whisker ].

[0005] As a slide member constituent which tried the improvement of the above-mentioned fault, what consists of three to solid lubricant 30 capacity [ , such as one to zinc oxide whisker 30 capacity %, zero to aromatic polyamide fiber 30 capacity %, and tetrafluoroethylene resin, ] % and remainder synthetic resin is known as indicated by JP,3-239756,A.

[0006]

[Problem(s) to be Solved by the Invention] However, even if it is the constituent which added the various above-mentioned fillers, a wear-resistant improvement cannot fully be aimed at and it cannot be said that there is still sufficient abrasion resistance as an ingredient which constitutes moving parts, such as a precise gearing, especially.

[0007] Then, this invention solves the above-mentioned trouble, and it has the sliding performance of low coefficient of friction which whose inclination to damage partner material at the time of sliding was small, and was stabilized in the slide member constituent, and, moreover, is making for abrasion resistance to consider as the extremely excellent slide member constituent into the technical problem.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, in this invention, a means to add the whisker 1 more than a kind chosen from the group which consists of a calcium-sulfate whisker, a boric-acid aluminum whisker, a magnesium sulfate whisker, a staple fiber-like composition calcium silicate hydrate, and a barium titanate whisker - 30 capacity %, aromatic polyamide fiber 1 - 30 capacity %, and a solid lubricant 3 - 30 capacity % was adopted by using synthetic resin as a principal component. Below, the detail is given.

[0009] First, it can be said that especially the synthetic resin used as a major component in this invention has more desirable heat resistant resin, such as polyphenylene sulfide (it is hereafter written as PPS.), a polyether ether ketone, polyacetal, polyimide, polyamidoimide, phenol resin, and an epoxy resin, since thermal resistance is required of a sliding condition or the environment installed in many cases although it may not be limited and you may be a polyamide, olefin system resin, etc.

[0010] Next, if it consists of anhydrous salt of a calcium sulfate, or a columnar crystal of a hydrate, the calcium-sulfate whisker used for this invention can be used without limiting a natural mineral or especially an artificial thing, and the fibrous thing (the so-called satin spar) of the chemical composition of  $\text{CaSO}_4$  and  $2\text{H}_2\text{O}$  can also be used for it by what is produced especially to nature.

[0011] Moreover, the boric-acid aluminum whisker used for this invention is chemical formula  $9\text{aluminum}_2\text{O}_3$  and  $2\text{B}_2\text{O}_3$ . Or  $2\text{aluminum}_2\text{O}_3$  and  $\text{B}_2\text{O}_3$  It is the white needle crystal expressed and 0.5-1 micrometer of diameters of average fiber and the thing of 10-30 micrometers of mean fiber length are desirable.

[0012] Among these,  $9\text{aluminum}_2\text{O}_3$  and  $2\text{B}_2\text{O}_3$  What is expressed It is 1420-1460 degrees C in true specific gravity 2.93-2.95 and melting point. An aluminum hydroxide and aluminum mineral salt at least A kind, It can manufacture at least by [ of the oxide of boron, oxygen acid, and an alkali-metal salt ] reacting and making 900-1200 degrees C heat and raise a kind under existence of the melting agent of the sulfate of alkali metal, a chloride, and a carbonate which consists of a kind at least.

[0013] In order to raise further the above-mentioned reinforcement effectiveness of a boric-acid aluminum whisker, it is effective to improve the wettability of a boric-acid aluminum whisker and the synthetic resin which is a matrix, and affinity by the surface treatment by the coupling agent. The coupling agents used at this time are a silicon system, a titanium system, an aluminum system, a zirconium system, a JIRUKO aluminum system, a chromium system, a boron system, the Lynn system, an amino acid system, etc. As a commercial item, they are  $9\text{aluminum}_2\text{O}_3$  and  $2\text{B}_2\text{O}_3$ . It is expressed and there is : Alvo REXX G by Shikoku Chemicals Corp., the diameter of average fiber of this thing is 0.5-1 micrometer, and mean fiber length is 10-30 micrometers.

[0014] The magnesium sulfate whisker used for this invention is white needle crystal fiber expressed with chemical formula  $\text{MgSO}_4$ ,  $5\text{MgO}$ , and  $8\text{H}_2\text{O}$ , and is 10-100 micrometers of mean fiber length. 1 micrometer of diameters of average fiber The thing of the following is desirable.

[0015] The staple fiber-like composition calcium silicate hydrate used for this invention is white needlelike impalpable powder expressed with chemical formula  $6\text{CaO}$ ,  $6\text{SiO}_2$ , and  $\text{H}_2\text{O}$ , and that aspect ratio has about 15 desirable thing. Such a synthetic calcium silicate hydrate mixes the nature raw material of a silicic acid, and a calcareous raw material with water, and is obtained by the hydrothermal synthesis of the lime by autoclave processing, and a silicic-acid system. Since what makes xonotlite ( $\text{C}_6\text{S}_6\text{H}$ ) a subject is excellent in thermal resistance as a crystal phase, it is desirable.

[0016] Moreover, the barium titanate whisker used for this invention is a chemical formula  $\text{BaTiO}_3$ . It is needle crystal fiber expressed and is the fiber length of 10-20 micrometers. 0.2-0.5 micrometers of diameters of average fiber A thing is desirable.

[0017] The loadings of five kinds of whiskers described above are one to 30 capacity [ of the amount of whole ] %, respectively independent or when it uses together. It is because a wear-resistant improvement effect is not seen, but 30 capacity % is exceeded, the damage degree of partner material becomes large if abundant, and abrasion resistance also falls on the contrary under in 1 capacity %.

[0018] Moreover, the aromatic polyamide fiber used for this invention can apply 5-25 micrometers of diameters of fiber, and a thing with a fiber length of 0.25-3mm, and can mention : Conex chopped fiber by Teijin, Ltd. as a commercial example. The blending ratio of coal of such aromatic polyamide fiber is one to 30 capacity %. because, the small quantity of under 1 capacity % -- if -- the large quantity which there is no mechanical reinforcement effectiveness of a constituent and exceeds 30 capacity % -- if -- since the resin melt viscosity at the time of shaping becomes high too much, a moldability becomes poor and it is because it is not desirable.

[0019] If it often distributes to the synthetic resin of a matrix as a solid lubricant used for this invention and sliding nature is given, it is not limited especially and selection use of the well-known solid

lubricants, such as tetrafluoroethylene resin, a graphite, and molybdenum disulfide, can be carried out widely.

[0020] The blending ratio of coal of such a solid lubricant is three to 30 capacity [ of the amount of whole ]-%. because, the small quantity of under 3 capacity % -- if -- necessary low coefficient of friction is not obtained as sliding material, but if the large quantity exceeding 30 capacity % is blended, mechanical strength will be spoiled, and the dimensional change by temperature becomes large, and it is because it is not desirable. And what is necessary is to face mixing these many raw materials and fabricating, and just to fabricate by the process condition of common knowledge suitable for the synthetic resin which is a matrix.

[0021]

[Function] Since the slide member constituent of this invention will raise a wear-resistant improvement of the aromatic polyamide fiber described above by the added aromatic polyamide fiber not damaging sliding partner material, but raising abrasion resistance, and being low coefficient of friction necessary by the solid lubricant, and blending a further predetermined whisker in multiplication, it turns into a slide member constituent with which abrasion resistance has been improved remarkably.

[0022].

[Example] It is as follows when the raw material used for the example and the example of a comparison is shown collectively. In addition, an abbreviated name is shown in [ ] and all the blending ratio of coal is capacity %s.

[0023]

(1) Polyphenylene sulfide [PPS]

East SOSA steel company make: #160(2) aromatic-polyamide fiber [PA fiber]

Teijin [ , Ltd. ] make: Conex (1mm of mean fiber length)

(3) Calcium-sulfate whisker [CaSO<sub>4</sub> whisker]

Great Nissei-ized company make: Franklin fiber (4) boric-acid aluminum whisker [AlBO<sub>3</sub> whisker]

Shikoku Chemicals [ Corp. ] make: Alvo REXX (5) magnesium-sulfate whisker [MgSO<sub>4</sub> whisker]

Ube Industries [ , Ltd. ] make: Moss Heidi [MgSO<sub>4</sub>, 5MgO, and 8H<sub>2</sub> O]

(6) Staple fiber-like composition calcium silicate hydrate [a calcium silicate]

(7) by Kawai lime industrial company barium-titanate whisker [BaTiO<sub>3</sub> whisker]

(8) by the Otsuka chemistry company glass-fiber Asahi fiberglass company make: Chopped glass fiber CS03DE404(9) zinc-oxide whisker [a ZnO whisker]

Matsushita Electric Industrial [ Co., Ltd. ] make: PANATETORA (10) tetrafluoroethylene resin [PTFE]

Made in Kitamura: After blending at a rate which showed the raw material more than KT400H

[examples 1-5 and the examples 1 and 2 of a comparison] in Table 1 and mixing with a Henschel mixer, the pellet for shaping was obtained with the kneading extruder. The obtained pellet was fabricated with the injection molding machine, the test piece was formed, the following trials were performed, and abrasiveness ability was investigated. This result was written together all over Table 1.

[0024] \*\* Using the measurement friction abrasion tester of a wear multiplier, consider as the mixture (PAI/PEI) of the polyamidoimide of glass fiber strengthening of partner material at sliding-velocity a part for /and planar pressure 5 kgf/cm<sup>2</sup> of 6m, and the temperature of 120 degrees C (ambient atmosphere), and polyether imide, and it is a wear multiplier (x10<sup>-10</sup>cm<sup>3</sup>/kg-m) at the conditions of non-lubrication. It measured.

[0025] \*\* The abrasion loss at the time of forming Gearing A in an example or the example of a comparison on condition that the following (mm<sup>3</sup>) was measured using the gearing endurance testing machine of a gearing durability test power absorption mold.

[0026]

Account gearing A: (Module m) =1, (number-of-teeth Z) =35, (face-width b) =8 gearing B(glass fiber strengthening PAI/PEI):(module m) =1, (number-of-teeth Z) =47, (face-width b) =8 load torque:5 kgf-cm Rotational frequency 300rpm, test time 160 hours, [0027]

[Table 1]

番号 項目		実 施 例					比 較 例	
		1	2	3	4	5	1	2
(容量%)	PPS (1)	65	65	65	65	65	65	65
	PA繊維 (2)	15	15	15	15	15	15	15
	CaSO <sub>4</sub> ウィスカ(3)	5	3	—	—	—	—	—
	AlBO <sub>3</sub> ウィスカ(4)	—	2	—	—	—	—	—
	MgSO <sub>4</sub> ウィスカ(5)	—	—	5	—	—	—	—
	ケイ酸カルシウム (6)	—	—	—	5	—	—	—
	BaTiO <sub>3</sub> ウィスカ(7)	—	—	—	—	5	—	—
	ガラス 繊維 (8)	—	—	—	—	—	—	5
	ZnO ウィスカ (9)	—	—	—	—	—	5	—
	PTFE (10)	15	15	15	15	15	15	15
摩耗係数 : ( × 10 <sup>-10</sup> cm <sup>3</sup> /kg-m)		152	175	192	181	146	636	330
歯車耐久試験: 摩耗量 (mm <sup>3</sup> )		4	2.5	4.4	3.7	3.8	8.7	6

[0028] Examples 1-5 did not damage partner material at all at the time of sliding, but the wear multiplier and abrasion loss are a notably low value compared with the example 2 of a comparison filled up with the example 1 of a comparison or glass fiber which consists of a slide member constituent filled up with the conventional zinc-oxide whisker, and they showed the physical properties which were extremely excellent in abrasion resistance so that clearly from the test result of Table 1.

[0029]

[Effect] The aromatic polyamide fiber which cannot damage sliding partner material easily in synthetic resin as this invention was explained above, A solid lubricant, and a calcium-sulfate whisker, a boric-acid aluminum whisker, Since it considered as the sliding material which carried out specified quantity combination of the whisker more than a kind chosen from the group which consists of a magnesium sulfate whisker, a staple fiber-like composition calcium silicate hydrate, and a barium titanate whisker The inclination to damage partner material at the time of sliding is small, and it has the stable sliding performance of low coefficient of friction, and there is an advantage which moreover serves as a wear-resistant extremely excellent slide member constituent, and it can be especially told to slide members, such as bearing, that it is the optimal.

[Translation done.]